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FROM THE
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OF ECONOMICS

REPORT ON A VISIT TO GERMANY,

WITH A VIEW OF ASCERTAINING

THE RECENT PROGRESS

OF

TECHNICAL EDUCATION

IN THAT COUNTRY,

BEING

A LETTER TO HIS GRACE THE DUKE OF DEVONSHIRE, K.G.

Lord President of the Council.

Sir Philip Magnus, Albert R. Redgrave, Swire Smith, and William Woodall, M.P.

Presented to Parliament by Command of Her Majesty.

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To Edward Atkinson Esq LL D
3
with Bruce Smith's kind regards.
2571/97.

Report on the Recent Progress of Technical Education in Germany.

To His Grace the Duke of Devonshire, K.G.

My Lord Duke,

A cordial invitation having been extended to a member of our party to visit the Electrical and Industrial Exhibition at Stuttgart, and to proceed thence to Nuremberg, where a national exhibition of arts and industries was also taking place, we arranged for a short stay in Germany, in the course of which we had several opportunities of inspecting schools and factories, and of comparing the existing state of arts and industries with the conditions which prevailed 14 years ago, when, as members of the Royal Commission on Technical Instruction, we made an exhaustive inquiry into these subjects. As the time at our disposal was limited, we were forced to confine ourselves to the inspection of a few representative schools and factories, as furnishing examples of the character of the changes which have taken place since our more thorough examination of these countries at an earlier date. We were able, however, to supplement our observations by an inspection of the contents of two important exhibitions, as typical of the existing state of the manufactures of Würtemberg and Bavaria. We had from time to time also the opportunity of discussing some of the questions which interested us with influential educational authorities, manufacturers, and merchants. During our stay, we had, moreover, the advantage of the guidance of Chief Councillor von Diefenbach, whose knowledge and experience of the schools and manufactures of these two countries was of the utmost value to us. Mr. von Diefenbach, it will be remembered, had an important share in the continuation of the great educational movement, inaugurated by the late Dr. von Steinbeis, a movement that has resulted in the creation of numerous thriving industries throughout Würtemberg, which, until the middle of the present century, was largely an agricultural country.

At a time like the present, when the effects of German competition have recently been prominently brought into notice and have attracted so much attention in this country, it was natural that this question should occupy our minds; but as in the case of the Royal Commission on which we had the honour to serve, it was our present task rather to compare the means of education available for the industrial classes, and the influence of such instruction on manufacturing and other industries, than

to endeavour to ascertain the general causes or the actual results of commercial enterprise. We are aware that any systematic investigation into these causes would necessitate the consideration of such questions as hours of labour, rates of wages, and the economic conditions under which different trades are carried on; and, although in the course of our inquiries we were able to gather information on these subjects, to which reference is made in this report, we have no desire to convey the impression that the accuracy of such information has been scientifically sifted, or that the extent of our inquiries would justify any final conclusions. We may, however, at the outset, state that we were greatly impressed by the progress which has taken place in many of the leading branches of manufactures since we passed through these countries in 1882.

It is satisfactory to be assured that our exports of manufactured goods to Germany compare so favourably with our imports, and that, moreover, the German empire is our largest customer. And while it is possible that the aggregate value of the foreign commerce of Germany in comparison with that of Great Britain has been overestimated, there can be no doubt that in certain industries our supremacy is seriously challenged. Germany is making enormous strides, and notably in those manufactures in which superior knowledge, technical skill, and the agency of the expert in chemistry or other sciences can be brought to bear. This holds good to a remarkable degree in certain industries concerning which we had special means of forming an opinion, namely, in the electrical trades and in the cognate branches of electrical engineering, as also in the colour manufacture and in various applications of printing involving artistic and scientific skill.

We were also struck by the marked improvement in the standard of living of the wage-earning classes, and by the growing tendency to the shortening of the hours of labour. There would seem to be a more prevalent opinion among manufacturers and factory inspectors that there is a maximum "labour day," and that any increase in the number of hours of labour beyond that maximum is bad in its effect on the quantity as well as on the quality of the output.

In the year 1882, we were present at the opening of the Fine Art and Industrial Exhibition at Nuremberg, and the exhibition buildings again this year occupied the same site in the beautiful park to the north of the city.

In certain of her industries, on the occasion of our first visit, Bavaria was still, so to speak, in her infancy; now we found large and populous factories, employing thousands of workpeople, where formerly there were workshops with but a sprinkling of artisans. Where once she relied upon machinery imported from England, now she produces a steadily increasing quantity of that required for the home trade, and finds new markets in other lands. Her railway system has been greatly developed and extended, and the disadvantage of her inland position and

her comparative remoteness from colonial and other markets is to some extent compensated for by very low railway rates for raw materials.

We may mention, as typical examples of progress, two industries which have practically been created since 1882. In that year there was not a single Portland cement factory in Bavaria, but now at one of the works alone 300 hands are employed, and about 50,000 tons of cement are produced annually. This business was founded only in 1885. The electrical works of Messrs. Schuckert & Co. (now the Elektrizitäts-Aktien-gesellschaft) were only just beginning on a small scale in 1882, and now they employ 3,500 workpeople, and export optical and electrical machinery to all parts of the world.

The development of lithographic colour printing works, such as those of Mr. E. Nister, of Nuremberg, affords another illustration of German enterprise resulting from the readiness of Germans to at once apply new inventions to productive industry. In these works, which are typical of others in Germany, numbers of illustrated books, besides large quantities of almanacs and Christmas cards, intended for the English-speaking markets, are printed, and the success of this industry is no doubt largely due to the scientific skill displayed in the processes of colour printing, as also to the ready supply of well-trained artistic operatives, of whom 140 were engaged in this factory at the time of our visit; the entire staff comprising 750 workpeople. It is worth noting, however, as indicative of the progress of art education in our own country, that nearly all the designs reproduced for the English market were the work of English artists. This very fact, however, only affords an illustration of another cause of German material progress, viz., the intelligent care displayed, and the efforts made to adjust the wares exported to the tastes and requirements of the market in which they are to be sold.

Among the many causes that have contributed to the advancement of German industry, we would particularly refer to the educational conditions upon which Germany has relied so largely in the past for the maintenance and development of her industrial progress.

The Commissioners set forth in their Second Report in 1884 the conclusions at which they had arrived with respect to the educational activity of Germany and the Continent, and it is impartant to record that since that time there has been no disposition to remain satisfied with past achievements. On the contrary, in nearly every case we found evidences of a determination on the part of the municipalities and of the State to increase and extend their schools, and to equip them with the most modern and improved apparatus. In these days of rapid intellectual progress the school becomes antiquated and obsolete almost as quickly as the factory or the workshop, and again and again we found that schools which had awakened our envy in 1882 and 1883 were being entirely rebuilt and replaced by

larger and more serviceable edifices. We shall have to mention, even in the few towns we visited, several instances where we found this to be the case, and the manufacturers who assured us of the importance of these institutions during our previous visit, were not a whit less convinced now of the urgency of the need of the additions and extensions which had since been made.

The great industrial art schools of Munich and Nuremberg vied with one another at the exhibition in the variety and extent of the works of their students, and we found that for the school at Nuremberg an entirely new building is in course of erection at an estimated cost of 45,000*l*. Separate departments are being provided for the day and the evening students, and special well-lighted class-rooms have been designed for all the different branches of art instruction, as well as for art in its varied applications to wood-carving, metal work, and general decoration. This school, when it is finished, will be one of the finest and most complete of its kind in Germany.

The Gewerbe Museum of Nuremberg has likewise outgrown its former habitation, and a handsome new edifice, conveniently situated, is even now partly occupied by the libraries and collections. In addition to the new buildings already finished, it is proposed to erect a separate range of laboratories and class-rooms for the section devoted to chemical technology, which since our former stay in Nuremberg has increased greatly in importance. These buildings when complete will cost over 50,000*l*. In connexion with the Gewerbe Museum there are courses of popular lectures, similar in character to those given at the Conservatoire des Arts et Métiers at Paris, on all new inventions likely to prove useful for trade purposes, and on other developments of science and art processes, which lectures are attended by large numbers of the working classes. In the laboratories a staff of professors and their assistants are employed on chemical research, and students desirous of conducting experiments under the direction of the professors in any special applications of chemical science to trade purposes receive gratuitous instruction. A special feature of this trade museum is the collection of specifications of patents carefully tabulated and open to all inquirers. This collection forms part of the statistical department of the museum, which also contains a history of all the factories of Bavaria, arranged in classes, giving a full account of the processes of manufacture, the number of machines used, the trade marks and patents owned, the horse-power employed, supplemented by any details which the owner may care to furnish respecting the number of the workpeople and the annual output.

At Stuttgart a somewhat similar museum, only opened in May last, has cost close upon 200,000*l*., and contains specimens of the art products of different countries, arranged after the manner of the South Kensington Museum. We have given a more detailed account of this museum in connexion with our description of the exhibition.

If we turn from art to science we find similar evidence, in the various towns visited, of the remarkable development of educational institutions and of such aids to industry as education is able to provide. We are led to believe that much more is being done for the training of those destined for the higher ranks of industry in many parts of Germany than in England, and this, too, notwithstanding the large sums entrusted to county councils and borough authorities under the provisions of the Local Taxation (Customs and Excise) Act of 1890. At Stuttgart we found that an entirely new group of buildings had been added to the Technical High School, one side, the chemical institute, reserved for the practical study of pure chemistry and the other for practical training in electro-technology. The Commissioners reported in 1884 that this Polytechnic had recently been enlarged at a cost of 75,000*l.* The erection and equipment of these new buildings has cost about 100,000*l.* Every new appliance that can aid the student in his scientific work is found in the series of laboratories of which this range of buildings consist. It is noteworthy that the instruction given in the Chemical Institute is exactly of the same kind as that given in the Universities, and, although a special feature of the teaching and of the equipment is the prominence given to electrolysis and to electro-chemistry generally, no attempt is made in these new laboratories to teach chemistry in its application to special industries, that part of the instruction being provided for in the main Polytechnic building. The electro-technical laboratories, housed in a separate part of the building, are perhaps only inferior to those still more recently erected in Darmstadt, and are splendidly equipped with every appliance for advanced practical instruction in all branches of physics.

At Darmstadt, a city of 57,000 inhabitants, the Polytechnic or Technical High School has been entirely reconstructed at an expenditure of about 120,000*l.* It consists of a main building for the study of mathematics, drawing, natural sciences, and engineering, and of two separate detached buildings, similar to, but larger than, those at Stuttgart, for the study of chemistry, pure and applied, and of physics and electro-technology. No thought nor money appears to have been spared in the erection and equipment of these buildings, which are the most complete of those we have yet seen. It must be remembered, in connexion with the expenditure on the above-mentioned institutions, that the cost of building in Germany is undoubtedly very much less than in this country.

Since this was written, we learn that a new Electro-technical Institute has been added to the Royal Technical High School in Hanover, opened by the Minister of Education in October 1895, which ranks side by side with these splendid establishments.

To the instances already quoted may be added the Technical High School of Charlottenburg, at Berlin, which was in process of erection in 1884, and which has since then been completed and extended (at an estimated expenditure of over 450,000*l.*),

and the unique laboratories for scientific measurements and research in the immediate neighbourhood of the Berlin School; these when visited by one of our party last year were still unfinished, but they now constitute probably the most complete institute in Europe for physical research.

These instances must be taken as examples only of the steady advance made by Germany in the last few years in the further provision of facilities for the higher scientific training as a means of developing her industries.

In our report already mentioned, we stated that the number of polytechnic schools was in excess of the requirements of the people, and we attempted to explain the fact by showing that when these schools were originally erected, "Germany consisted "of several independent States, which have since been united "in the German Empire, and which endeavoured to rival one "another in the extent and excellence of their educational in-"stitutions." Since then Germany has had time and opportunity to reconsider her position, with the result that whilst none of these institutions have been closed, others have been erected more modern in construction, more completely equipped, and better adapted to the now generally recognised need for practical instruction.

To mention one instance only of the efforts made on behalf of trade teaching, we may refer to the Weaving and Dyeing School at Crefeld, which was only completed in 1883 at an estimated cost of 42,500*l.* This has been almost doubled in size by the erection of a new detached building, costing upwards of 15,000*l.*, for the departments of dyeing and finishing; and this school, which we then described as the finest of its kind in Europe, and far surpassing anything of a similar character in this country, has not remained satisfied with the position assigned to it fourteen years ago. The cost of this extension has been defrayed by the State.

In fact our recent visit has brought it clearly home to us that the Germans have not ceased to believe in the value of the higher scientific education. On the contrary, they appear now to attach greater importance than ever to the connexion between such higher scientific training and the development of manufacturing industry. No nation not overburdened with capital would continue to erect and equip institutions for advanced instruction and scientific research without a firm conviction of their industrial value. The demand, too, for such higher teaching seems to increase as the facilities for providing it are enlarged. For, whereas in 1884, we stated that the total attendance at the Polytechnicums was little more than 2,000, the attendance of students at Charlottenburg alone, irrespective of the Berlin University, is now 3,000, while the number of students in the physical and electro-technical laboratories at Darmstadt is already in excess of the accommodation, and the buildings, which were only completed in October 1895, are now undergoing extension.

Indeed, it is worthy of remark that the same object which called into existence some 40 or 50 years ago the technical high schools has recently led to their extension and development in a new direction. As far back as that period Germany began to prepare herself for becoming a manufacturing people. It was her belief in the future applications of chemistry to industrial purposes that led to the erection and equipment at a great cost of chemical laboratories, and to the encouragement held out to students to pursue their studies in those laboratories for a period of five, six, or even seven years. The success that has attended the efforts of the Germans to appropriate many important branches of chemical manufacturing industry is well known, and the dependence of those industries on the researches of chemical experts employed in the works is generally recognised. At the Badische Anilin- und Soda Fabrik alone, 100 scientifically trained chemists and 30 engineers are now employed.

Her brilliant achievements in the field of chemical industries have encouraged her to establish well-equipped electrical laboratories and to develop the practical teaching of physics with the view of assisting the electrical trades, which are comparatively of recent growth. Twelve years ago the Commissioners had to report that the facilities for practical laboratory instruction in electrical technology scarcely existed, or were of the most meagre kind. At that time nowhere in Germany was to be found so well-equipped a laboratory for electrical engineers as at the Finsbury Technical College. Now there are no laboratories in England which can compare in the detail and completeness of their equipment with those we visited at Darmstadt and Stuttgart; and no facilities exist for original and independent research in physical subjects to be compared with those afforded at the Imperial Physical Institute at Charlottenburg.

Our recent visit to Germany has also impressed us with a sense of the advantages which the nation derives from having an organised system of secondary education. To this matter reference was made in the Report of 1884, and we desire to emphasize it. The education of a secondary school is in every way more accessible in Germany than here. The grades and differences of schools are better defined and more clearly understood; the instruction is more disciplinary and exercises a deep influence in the formation of habits and in the training of character; the teaching of modern languages is insisted upon to a far greater extent than in any of our own schools, with results of the greatest possible benefit to the German clerk and commercial agent; the absence of frequent and conflicting external examinations gives more time for careful study; the remission of two years' military service to those who reach a certain standard in a secondary school is a powerful encouragement to steady application; and the fees are much lower than in schools of corresponding grade in this country. These are advantages which count for much in

enabling the German youth to obtain a good secondary education and in fitting him for the subsequent period of apprenticeship in the counting house, the merchant's office, or the factory. The German boy acquires at school a stock of knowledge which is at once useful to him, and he also acquires habits of accuracy and learns the significance of attention to detail and the importance of discipline and obedience. Our consular reports are full of references to the differences between the methods of training and aptitudes for commerce in Germany and in England, which in many ways are traceable to the fundamental differences in the secondary education of the two countries.

As regards trade schools, we found that these are more common in South Germany, as, for instance, in Austria, than in Prussia, and we were struck with the recognition of their importance, as shown by the fact that, in the exhibition at Nuremberg of the products of the different provinces in Bavaria, specimens of the work of the pupils of trade schools were in many cases displayed in connexion with the exhibits of the factory or workshop, indicating the close relation that appeared to exist between the school exercises and the work of the manufacturer. The instruction in these trade schools is essentially practical, and has been very helpful in the development of several of the smaller industries.

The lesson to be derived from all this activity in matters pertaining to education is clearly this, that our foreign rivals are determined to keep well ahead in the matter of facilities for instruction, and not only so in those institutions wherein the highest branches of scientific instruction are pursued. They are convinced that the nation which has the best schools is the best prepared for the great industrial warfare which lies before us, and no money appears to be grudged for the erection, equipment, and maintenance of educational institutions of all grades, and especially of the science laboratories which, as we have seen, are being multiplied in Germany. The great industries of to-day depend more and more upon the successful application of recent discoveries to ordinary manufacturing processes and less and less upon the presence of coal, iron, and raw materials. Cheaper and more speedy means of transit are placing all countries more nearly on a level as regards natural resources. Improved tools and labour-saving machinery are rapidly rendering the manual skill and dexterity of the individual workman (upon which we once so greatly relied) of minor significance, and in the industrial race in which we are engaged nearly all the advantages upon which we prided ourselves in the past are possessed in a greater or less degree by our rivals, and count for little as compared with scientific knowledge and its ready application to the needs of the manufacturer.

As regards the facilities for instruction to artisans, we did not discover that, except perhaps in certain branches of the textile industries, the special technical education of the German workman is superior to that of the artizans of this country, and notwithstanding the existence of evening con-

tinuation schools and Sunday schools in many parts of Germany, we have no reason to think that better facilities for technical and scientific teaching are offered to foreign workmen than those within the reach of our own industrial population. Indeed, in some respects the recent development of evening technical instruction under our County Councils gives an advantage to our own workpeople. At the same time there is a growing recognition in Germany of the desirability of making further provision for the instruction of workmen and foremen in trade subjects. We are especially impressed with the fact that employers in Germany largely encourage their apprentices to attend evening schools, and, whilst different regulations obtain in different trades, we found that in some industries the apprentices have two afternoons free each week for attendance at technical classes.

In the evening schools which we have recently visited the instruction is not so much the teaching of handicrafts as is the case in some of our own technical classes, but is more distinctly supplementary to the workshop practice. The methods of teaching vary with the subject, and more care is shown in specialising the instruction in drawing according to the trade of the various classes of students than is common in our own schools. In the weaving schools, which are much attended by evening students, the instruction is essentially practical. These schools form a very distinct class, and some of them have been largely developed since the publication of the Report of the Technical Instruction Commission.

It is to be noted that the pupils enter the evening classes with a better preparation for technical instruction than our own students, owing to their elementary education having been continued to the age of 14, and to the system of instruction, which in many ways is more formative of sound habits of thought. Moreover, many of those employed in engineering and other works have had the advantage of attending a good secondary school before entering the evening classes, and the kind of instruction which these need is very different from that which can only be assimilated by pupils whose education has been interrupted at an earlier age.

Although, therefore, we are prepared to repeat as regards Germany what we stated in 1884, that there is no organisation for evening instruction in science and art comparable to that afforded under the Science and Art Department and for the examinations in technology under the City and Guilds of London Institute, we feel that no conclusion can be drawn from a comparison of the systems of evening technical teaching without taking note of the differences that exist in the elementary and secondary education of the two countries.

In making even these superficial comparisons between the industrial development of Germany and that of England, we ecoumised our time by selecting certain specimen districts in which some of the most important industries of the country are centred, and choosing those the products of which are largely exported. In

the inquiry of the Commissioners in 1882, the worsted industry of Saxony was carefully inspected and examined, and it was shown, at that time, that the conspicuous progress of the manufacturers had been materially aided by the schools of art and science, by general artistic, scientific, and chemical training, and especially by the weaving schools, in which the fullest opportunities were provided for the application of science and art to the manufacture of textiles. Undoubtedly the progress in these centres has not only been sustained, but has been relatively increased, as is borne out by the rapid growth of their manufactures and by the increase of their exports. In a very interesting interview with Mr. Monaghan, the American Consul at Chemnitz, who for some time has given attention to questions relating to education and industry for the benefit of the United States Government, we received full confirmation of the opinions we had formed in the course of our previous inquiry as to the thoroughness and utility of the training for the work of life which the German students receive. "They begin," he said, "by learning the "language, manners, and customs of the people with whom they "trade, and by mastering the anatomy of every machine they "have to work." This gentleman accompanied us to the weaving school, with all the arrangements of which he was familiar; and not content with verbally describing the influence of the school upon numerous leading designers and manufacturing experts with whom he was acquainted, he conducted us to the business office of a practical designer who had gained his knowledge at the school, and who by his faculty of making patterns that had caught the public taste had lifted the concern in which he had been employed into a prosperous condition. Mr. Monaghan had no hesitation in saying that if his country and ours did not meet Germany more thoroughly and more practically in the school, each would, in the course of a few years, be compelled to yield to Germany the first place in all the higher and more profitable fields of manufacture and commerce.

As regards worsteds, both in Germany and in England, spinning and weaving had been carried on for centuries as hand industries. The spinning trade in Germany was practically crushed out by England, but the hand looms remained and are still extensively worked as supplementary aids to the family income in the rural districts. With the advent of British machinery, the competition with this country began, although it was practically unfelt so long as British manufacturers were busy. Hitherto it has been mainly confined to weaving. The industry has always been much less centralised than in England, and circumstances necessitated that in most of the factories the weaving, dyeing, finishing, and making-up should be done on the premises, an arrangement which is usually in force to-day. The manufacturer by his travellers sells direct to the retailer. The conditions prevailing in the same industry tend in the case of England to economy of production, while in Germany they tend to variety and originality.

It may be noted also that, as in England, certain power looms were employed in the making of common goods for Germany, so

the German manufacturers, aided by protective duties, first used their English looms for the manufacture of these common goods for themselves from yarns imported from England. The competition at the outset was met by efforts on the part of our English manufacturers to overcome the tariffs by still further cheapening this class of goods, a competition which in most instances they were compelled to relinquish. The Germans, however, no longer confine themselves to the manufacture, for export purposes, of one class of goods; and it is now in the better kind of fabrics that, helped by their schools of design, and by weaving and dyeing schools, and by their intimate study of the methods of commerce, they are destined to become our most serious competitors.

The methods pursued by German firms in buying yarn in England for the making of German fabrics furnish an apt illustration of the practical character of their enterprise and education. Within the business experience of many still living, a firm of English merchants in Bradford started a department for the export of yarns to Germany. They did not send an English traveller to Germany for the simple reason that few English travellers could speak German. They accordingly engaged a German to manage the new department. Very soon Germans found it advantageous to settle in Bradford, where, owing to their knowledge of English, which they had learnt at school, and their ability to keep foreign commercial accounts, they found no difficulty in conducting their business. As a matter of fact, at the present time, the export yarn trade of Bradford is practically in the hands of Germans, concerning whom it may be said that none are more prompt in meeting their engagements or more honourable in their business transactions.

The yarn is distributed by the merchants to German manufacturers, and the German worsted textiles which are imported into this country are mainly composed of yarns made in Bradford. The Bradford trade is a good example, not of the harmful, but of the profitable effect of German competition, and it would be difficult to say which country has benefited the more by it. The annual amount of woollen, worsted, and alpaca yarns exported from England to other countries, largely to Germany, during the following periods of years has averaged as follows:—

	lbs.	
1880–85 - - -	37,800,000	per year.
1890–95 - - -	60,000,000	„
1895 - - - -	78,900,000	„

Bradford has been the greatest contributor to German success in the weaving of worsted and alpaca cloths, and Germany has been the greatest contributor to the success of the spinning trade of Bradford by purchasing the yarns manufactured in the district. Even for this gain to English trade we are, however, indebted to German education; for we are told that if Bradford had depended upon English travellers and agents in Germany to push the sale of her yarn, the Germans by this time would

probably have been spinning the yarn for themselves, and possibly exporting some of it to England.

At the present time the worsted spinning industry of Saxony is mainly confined to what is known as the French (mule) system, and most of the machinery is made in Germany. Such long wool-spinning machinery as is being employed is still imported from England. In weaving, Germany has passed beyond this point and is largely engaged in the manufacture of her own machinery. In travelling from the Bavarian border northward through Saxony to Chemnitz, we were much impressed by the evidences of growth and prosperity in the manufacturing towns through which we passed. In one of these towns which is largely employed in weaving Bradford yarns, we were informed by the agent of an English loom maker, who, on a previous visit, personally conducted us through some factories, that nearly all the power looms, used at that time, were supplied by Yorkshire makers. On our recent visit we ascertained that there were no longer any resident agents of English makers, but that two loom factories had been erected in the town, and that the import of English looms had almost ceased.

The experience of Saxony in her competition with England in the wool and worsted industries is practically that of other German States in other trades. At first, Germany came to England for the manufactured product, then for the machinery for making the product, and latterly in some instances Germany is found able not only to use English machinery more effectively than is being done at home, but to compete with us in the production of it. On the other hand, still taking the case of Saxony, we do not find that English loom makers have done less business, or reduced the wages of their workmen since the Germans began to manufacture power looms for themselves; as a matter of fact the home trade has, so far, increased, and the competition has resulted in additional improvements in the construction of looms and in the machine tools which are so largely used for that purpose.

We found in this district of Saxony, as also in much of the country southward, stretching into Bavaria a primitive condition of things which one would scarcely have expected under the highly developed organisation of commerce in Germany. We were informed that there are still about 12,000 hand looms employed, and that in the sparsely populated villages, stretching in every direction from the town of Meerane, nearly every cottage has its loom. The peasant proprietor and his family work upon their little patch of land, getting out of it all they can, and fill up their vacant time in turn at the loom, or at some other home industry. Our attention was called to a group of women, each with her small waggon drawn by a large dog, bringing her piece of cloth to the warehouse of the factor or employer, and taking back with her one or two bundles of worsted yarns, besides loaves, sugar, coffee, &c., and oil for the lamp. Some of these hand loom weavers are wonderfully expert.

We saw a pattern weaver who cheerfully boasted that he could make his loom do everything but talk. He was at work in a little chamber, in which there were two beds besides his loom, and he was one of 50 employed by the same firm exclusively in the making of patterns. We were frequently informed that orders are accepted for single pieces of complicated patterns woven by hand. The variety and excellence of many German fabrics is explained by the fact that they are made in hand looms; and having regard to the diversity and beauty of the patterns, it is to be regretted that the products of the hand loom as against the power loom have to meet a hopeless competition. The hand loom weavers, and equally those employed on the power loom, have been much assisted by the instruction gained in the weaving school of the town of Meerane, which, established on a small scale 45 years ago, is now installed in a new building, and is attended by over 100 students. We were told that the most earnest of these students are the hand loom weavers from the country districts, and that all the employers had attended the school; and some of the most prosperous of them stated that they owed their success entirely to its influence.

Besides weaving, a large number of other home industries are carried on by cottagers in their spare time. In some districts, as is the case in Thuringia and in the Black Forest, they carve wood, make clocks, dolls, toys, lace, artificial flowers, &c., and in many of these industries the art instruction they receive at school stands them in good stead. A merchant in Bavaria, whose warehouse we visited, told us that he had 30,000 separate patterns of articles for sale made in cottages, and that he had orders for all kinds of toys, including 12,000*l.* worth of dressed dolls. Of the toys imported into this country in 1894, the value of which was nearly 1,000,000*l.* sterling, nearly all came from Germany.

The questions of longer hours, smaller wages, and the work of women and children are all to some extent involved, as we have said, in the growing competition which the manufacturers of this country have to face, but we are convinced from our inquiries that there has been in the past, and that there still is in progress, a levelling up of the inequalities between the physical and social condition of the workers here and those in similar trades abroad. In all skilled industries the wages in Germany are rising, and the hours of labour tend to decrease. Child labour has practically disappeared in German factories, as in no case at any works visited by us did we see any children employed.

In certain trades, however, the inequalities in hours and wages that still exist may apparently give to the German employer some advantage over the manufacturer in this country, but we think that this is a factor in the present competition which is yearly becoming less important.

In the attractive appearance, the pattern, and the finish of their goods, and in the excellence of the packing, the German producers take infinite pains, which it clearly pays them to take.

In these directions many of our countrymen have undoubtedly much to learn.

The Merchandise Marks Act, as it now operates, was generally spoken of as a strong weapon against ourselves; and while the forging of trade marks, for the prevention of which it was originally devised, has long been illegal, the measure tends to act as an advertisement of the industries of our foreign rivals, and serves to indicate to the colonial and American buyer the true origin of much that he had hitherto been in the habit of regarding as English.

In many parts of Germany great efforts are being made to extend the provision of light railways, and to stimulate trade by the lowest possible rates of carriage. We were assured that merchandise abroad is conveyed at a much lower rate than in this country. The remoteness of the country from the coast renders this the more necessary and the more difficult to introduce generally.

We shall have accomplished all we hoped to do as the result of our somewhat hasty mission if we succeed in showing that there is no evidence of standing still or of being satisfied with past progress in any direction in Germany. Everything is still being developed, and in all branches of industry there are signs of great activity. New factories are being erected and new processes are being invented. Indeed there are indications that in the immediate future our own countrymen will have to encounter a competition far more acute than anything they have yet had to grapple with. In the coming struggle for trade, our fine insular position, our splendid race of workers, and our excellent raw materials will undoubtedly count for much, but the possession of these advantages alone will not suffice, and we shall have to adopt certain of the methods which prevail abroad, about which our manufacturers in the past have cared too little, but which mean much to our customers. We must not be content to live any longer upon the traditions and reputation of the past, but we must set ourselves to work diligently to study the wishes and fancies of those we have to serve, and we must moreover be prepared to meet them even in such small subtleties as weights, measures, and packing. Above all, we must endeavour to improve and to develop our higher, industrial, and secondary literary and technical educational machinery, and, whilst adapting this machinery to our peculiar conditions, we must see that it is maintained at least on a level with that of any other nation.

We append some of our notes at greater length on the schools, exhibitions, and upon certain of the factories visited by us, which notes have served as the basis of the conclusions that we have ventured to submit for your consideration, and we trust that we may be permitted to take this opportunity of expressing through your Grace the obligations we are under to Her Majesty's Ambassador at Munich, the Ministers of Church and School Affairs of Würtemberg and of Bavaria, and the officials of the

exhibitions in those countries, as also to the numerous manufacturers and others who afforded us opportunities for the prosecution of our inquiries.

We have the honour to be,
Your Grace's obedient humble servants,
(Signed) PHILIP MAGNUS.
GILBERT R. REDGRAVE.
SWIRE SMITH.
WILLIAM WOODALL.

We regret that we were unable to accompany our late colleagues of the Technical Instruction Commission on their recent visit to Germany. We have, however, had the advantage of reading their Report, and we desire to say that we are in general agreement with the opinions expressed by them in regard to the instruction to be derived from their observations.

(Signed) B. SAMUELSON.
HENRY E. ROSCOE.

I have had independent opportunities of verifying the conclusions in respect of the mischievous operation on our trade of the Merchandize Marks Act, of the burden imposed, more especially on our exports, by the comparatively high rates of the British railways, and of the great advantage derived by foreign manufacturers by the superior training of their commercial travellers.

(Signed) B. SAMUELSON.

December 1896.

Notes on Schools, Exhibitions, and Factories.

The Darmstadt Polytechnic.

The new Polytechnic at Darmstadt, erected in place of an earlier building, was specially visited in order to see the most recent development of schools for the highest branches of technical teaching. The main building is three-storeyed, and comprises three wings at right angles to it, giving an E-shaped plan. These buildings are devoted to the teaching of mathematics and some branches of natural science, and to the schools of architecture and engineering. In the wing buildings, moreover, the first year students receive their instruction.

Opposite to the front entrance to the Polytechnic, and on the other side of the road, are two separate institutes, one of which contains the physical and electro-technical schools, and the other the chemical laboratories and class-rooms. In the rear of the main building is the engine-house, from which electric light, and power and heat, are supplied to all these buildings. The Polytechnic, which was begun in 1893, was completed in October 1895 at a cost, including fittings and equipment, of about 120,000*l*. The main building contains the usual series of drawing offices—a special feature of every technical college in Germany—rooms to contain the collections of models and apparatus, the engineering laboratories, class-rooms, lecture-rooms, a large hall, the library and the offices for the administrative staff.

The most interesting department of the institute is undoubtedly that devoted to the physical and electro-technical schools. This is divided into two distinct sections; the one for instruction in physics proper, including electricity, and the other for the technical applications of electricity. It is in this special direction that so much progress is being made in Germany, as evidenced by the new buildings at Berlin, Leipsic, Hanover, and Stuttgart. Each section of the physical school contains workshops for the making and repairing of apparatus, but these workshops are not used by the students. In fact it may be said that manual training of this kind does not even now form any part of the curriculum of the students at the German technical high schools. They are required, however, during their course of study, to spend part of their long vacations in engineering shops, and arrangements are made for the admission of students to the State railway works, or to the machine-shops of well-known electrical firms.

The apparatus of the two divisions of the physical and technical institute is necessarily, to some extent duplicated, and the more so as the schools are kept quite distinct; but there are some advantages in the two departments being housed in the same building. Each department contains separate laboratories, carefully fitted for experimental work, and provided with the necessary apparatus and appliances for accurate measurements. In the basement of the physical department is a room specially fitted with double walls for experiments requiring uniform temperature, rooms for chemical and photographic work, an engine-room containing a gas-motor, dynamos, and other machines. On the ground floor are separate laboratories for the professor of physics, Dr. Shering, and for the chief assistant; a laboratory for magnetic experiments, free from iron fittings, and other separate laboratories for galvanic, optical, and photometric work: and above this floor are the balance-rooms, two lecture theatres and preparation rooms, and additional laboratories for exercises and experiments in heat and light.

The electro-technical section of this building has, on the basement, rooms for accumulators, for testing arc and glow lamps, for the testing of cables, besides the dynamo and engine laboratories. These are all carefully equipped with appropriate instruments and apparatus. Above are the private laboratories of the professor, Dr. Kittler, and of his assistants; laboratories for measuring the strength of different currents, for magnetic investigations, for determining resistances, co-efficients of induction, &c.

The arrangements for lighting the lecture-rooms, and for the conveyance of currents from different combinations of batteries are very complete, and give evidence of the thought and care expended on the equipment of the school. To each laboratory separate currents are supplied from the galvanic batteries and dynamos, from the main current machine, from the accumulators, and from the central electric station in the rear of the main building. The network of wires, which can be connected in different combinations for experimental purposes, with the carefully designed switch-boards, have been fitted by Messrs. Schuckert of Nuremburg, in whose works are found a large number of the students who have received their training in this school.

There are already 300 students in this one department of the Darmstadt High School, and the building, which was completed in October 1895, is now being extended.

The course of instruction covers four years: the first year is spent in the main building, in a general course of scientific study; the second is given up to physics, and the last two years are devoted to practical exercises in the electro-technical institute.

The chemical school is housed in another separate building, which also consists of two departments; the one for the study of pure chemistry, the other for the study of chemical technology, electro-chemistry, and pharmacy. The department of pure chemistry consists of three large laboratories for analysis and preparation work, and a number of smaller laboratories for special researches. It has accommodation for 60 or 70 students. There are separate rooms for thermo-chemical, spectroscopic, photometric, and other physical experiments, as well as rooms for chemical investigations connected with secondary and other batteries.

The other side of the chemical school is mainly devoted to the study of electro-chemistry, and is equipped with the necessary apparatus and machinery, including continuous and alternating current dynamos, for experiments and researches in this special branch of applied chemistry. It would seem that there are at present 39 students in this department alone.

The attendance of regular students in the various faculties during the past year amounted in all to 850, and there were 104 occasional students, making a gross total of 954. The teaching staff consisted of 27 ordinary and of six extraordinary professors, 22 demonstrators or instructors, and of 22 assistants, making a total of 77. The students' fees vary from 8*l.* to 12*l.* a year, and the deficit on the cost of maintenance is defrayed by the State.

The New Buildings of the Stuttgart Polytechnic.

We visited also the recently-erected buildings for chemistry and electro-technology that have been added to the Technical High School of Stuttgart, which, as is well known, is one of the oldest polytechnics in Germany. On the occasion of our visit in 1882, we found that considerable extensions had been made in 1879, consisting of two new wings, at a cost of little short of 75,000*l.* The present buildings, which are entirely detached and situated at some distance from the main building, have involved for their erection and equipment and expenditure of about 100,000*l.* One half the building is devoted to the chemical department, and the other and rather smaller half is allotted to electro-technology. There is a substantial basement with two lofty storeys above ground. The chemical department is devoted to the teaching of pure chemistry, inorganic and organic, and the laboratories in the main building, which were previously used for this purpose under Dr. von Fehling, are now occupied by the professor of chemical technology, Dr. Häussermann. The new laboratories, which are housed in what is practically a separate and distinct building, have been planned with the utmost care and forethought. They have accommodation for 76 students, and there were 62 students last year in attendance. The laboratories have been opened only a year and a half. The course of instruction occupies six semesters; many stay less time and go on to the university; but the majority of

the students continue their studies either at the Polytechnic or the university beyond the three years. The first year is devoted to inorganic analysis, the second to organic analysis, and the third to research work. The laboratories and lecture-rooms are very completely equipped. Besides the ordinary lecture-rooms and laboratories, are special rooms for accumulators, for motors and dynamos, dark rooms for photographic and photometric experiments, rooms fitted with furnaces for metallurgical work and the usual balance-rooms.

The electro-technical department adjoins the chemical laboratories, but occupies a separate building. It is under the general direction of Dr. Dietrich. It was constructed for 120 students, and during the last session there were about 75 students in attendance. Commodious as is the building, we were told that there was not room for more than 20 advanced students. The institute contains a large number of small laboratories, specially fitted for experiments in some one branch of electrical work. Several of these laboratories were intended to be occupied by one student only. We saw one large room well stocked with different kinds of electrical apparatus and fittings; but in the several laboratories, the instruments were kept on the tables and benches ready for experimental work. We were struck with the number and excellence of the equipment of the several laboratories, which included rooms for magnetic experiments, for dynamos and accumulators, for photometry, for measurements of different kinds, for experiments requiring uniform temperature, for transformers, for cable testing, &c. We particularly noticed in one of the assistants' rooms a glass case containing surgical appliances ready for use in the event of an accident to any of the students or staff. Fire-extinguishing jets had also been fitted up in all the laboratories in case of accidents or explosions. The room occupied by the accumulators measured 50 feet by 12, and we counted in the dynamo room six motors of three different types, and four pairs of different dynamos. Heavy goods were taken from the basement to the floors above, by means of an electrical crane, which was in good working order. The building contained also a well-fitted shop for the making and repairing of apparatus, all the machinery being driven by electro-motors; but workshop exercises formed no part of the students' course.

The course of study occupies eight semesters or four years, and during this period the student is expected to spend one year with a firm of engineers. The students seldom complete their school course before 18 or 19, and rarely pass their qualifying examination as engineers before the age of 24.

The Crefeld Weaving School and the New School for Dyeing and Finishing.

The 12 years which have elapsed since the publication of the Commissioners' report have served still further to test by practical experience the value of the several weaving schools which are found in different parts of the continent. The most important of these formerly visited by us was the weaving and dyeing school at Crefeld, and as we were informed that this school still takes the lead, we inspected it with some care under the guidance of Herr Lembcke, the director. At the time of our previous visit to Crefeld, the school was situated on the outskirts of the town, the population of which did not exceed 90,000; at the present time the population has increased to 110,000, and handsome streets and important buildings surround the school. The school was originally erected at a cost of 45,000*l.*, and it was anticipated that the accommodation provided would be amply sufficient for the wants of the whole district for many years to come. We found, however, that the dyeing and finishing departments had for some time become too small, and as they did not admit of enlargement a new building had been erected for these branches of study on a piece of land outside the town at a cost of 15,000*l.* The rooms in the original building thus set free are to be fitted up with a complete set of cotton spinning and knitting machinery, and the instruction generally has been so extended as to cover the whole range of complicated details in

connexion with the designing, weaving, dyeing, and finishing of textile fabrics.

Of the many interesting features of this school, the museum, which is said to contain the finest collection of textile patterns of the world, is the most noteworthy. The decorations alone of these galleries have cost 6,000*l.*, and the librarian in charge told us that the museum had been visited by over 10,000 persons during the present year, whilst designers from different factories visited it daily, many of whom would be found engaged there, often at the same time, in copying and drafting patterns. As the result of the exhibition of Persian and Turkey carpet patterns, an industry for the making of Smyrna worsted rugs had been recently started in the town, giving employment to 120 operatives.

The library and reading room, which are open to the public on certain days in the week, are well attended, and contain all the important textile books that have been printed in any language, including the British textile journals, which are found displayed on the tables. The sum of 1,500*l.* was originally granted for books, but this amount has since been increased.

We inspected the several designing rooms, class-rooms, art studios, and lecture theatres, rooms for the decomposition of patterns, and the collections of raw materials, and we found nothing wanting to make the equipment of the school thoroughly up to date. In the spacious quadrangle, the large top-lighted weaving shed contains 88 different kinds of power looms, several of which are run by separate electric motors, besides 44 hand-looms. We were informed that in no factory in the world, and certainly in no other school, are found so many varieties of looms, or woven fabrics.

The new dyeing and finishing school consists of a lofty three-storeyed building, containing a series of top-lighted sheds for the machinery and work rooms. The laboratories for the analysis of colours and for private research are very extensive, and the dyeing school contains every essential that is found in the most complete dye-houses. The finishing department is equally well equipped, no expense having been spared either in the provision of the largest machines, or of the smallest details. We were told that no commercial establishments were better equipped than this school, and that consequently every student passing through it had the advantage of starting on his business career with the full knowledge of the newest facts and methods.

The school at Crefeld with its departments for the application of art and science to the designing and dyeing of silk fabrics must be regarded as affording another instance of the belief of German manufacturers in the value of the best artistic and technical instruction. They recognise that it is the design and finish that sell the fabrics, and they have therefore spared no expense in the equipment of their schools, and in the provision of the best instruction.

By the President of the Chamber of Commerce and by other leading citizens, the school was represented as the centre of inspiration for the manufacturers of the whole district. The designers who have passed through it are kept in touch with all that it can teach by attending the conferences and lectures. If they wish for the adaptation of old forms and ideas in making their patterns, they can go back to the best designs of every period. In the dyeing and finishing departments all new processes and colours are tested and analysed, so that nothing is left to chance. The silk industry of Crefeld, like that of England and France, is exposed to constant fluctuations, and for some years, especially in those following the enactment of the McKinley Tariff Bill in America, it was greatly depressed. In 1894 the silk exports of Germany amounted in round figures to 7,400,000*l.*, but rose in 1895 to 8,300,000*l.*, of which improvement perhaps the principal share came to Crefeld. One of the large manufacturers informed us that formerly his firm employed 3,000 hand-looms, but they now used only a tenth of that number. In the transition from hand to power looms many weavers have suffered. But in spite of tariffs and competition, and changes of fashion, it was maintained that Crefeld had kept abreast of the times, and had grown in material well-

being and population, while the silk industry in England has been languishing. Indeed, Crefeld sends the bulk of her productions to England. It was pointed out, moreover, that owing to the many directions in which the school had fostered practical teaching, it had become possible, when the silk trade was depressed, to initiate new textile industries in Crefeld which might serve to occupy her machinery and find employment for her artizans.

The Trade Museum of Nuremberg.

On the occasion of our visit to the Gewerbe Museum, Nuremberg, we were met by Herr L. Erhard, the Curator of the Mechanical and Technical Division of the Museum, and Dr. P. J. Ree, the Librarian and Secretary. Handsome new buildings were nearly completed to replace the old ones in the centre of the town, which have been lately given up. This institution, described by us in our former reports, is somewhat on the model of that of Stuttgart, but contains certain features which are peculiar to it. The Director of the Museum is Herr Th. v. Kramer, who is also the architect and director of the Exhibition. According to the prospectus the work of this institution is carried on under eight different divisions:—

1. The collection of patterns or samples, which consists of 10,000 specimens of ancient and modern examples of works in wood, metal, glass, clay, leather, and paper. Also woven fabrics, embroideries, laces, &c. Certain of these objects can be obtained on loan. This section is really the applied art museum, as the specimens comprise examples of workmanship from all countries, and of the best periods of art.
2. The collection of designs, which consist of some 60,000 sheets of illustrations of art industries of all periods and all nations. These mounted sheets are classified under various heads, and arranged in glass cases for easy reference by manufacturers and students. To procure these designs recourse has been had to illustrated works on ornament and art workmanship, and to the best serial publications of all countries. Opportunity is afforded for consulting them and for copying them, and the officials undertake to prepare special designs and sketches, for fees to be arranged.
3. The library and reading room contains upwards of 13,000 volumes of art, industrial, and technical works, also about 136 journals and periodicals relating to these subjects, which are taken in regularly and filed. In connexion with this section we noticed an extensive series of foreign directories, trade catalogues, and address books of other countries.

   All the above departments are open free to the public.
4. The Mechanical and Technical division may be said to include two chief departments:—

   Section I.—The office for specialised trade information relative to:—

   (*a.*) Patents, merchandise marks, and trade marks. In this section applicants can have patents secured for them at fixed charges, and trade marks can likewise be registered.

   (*b.*) For furnishing information of all kinds on motors, machines, tools, raw products, and manufactured goods.

   (*c.*) For supplying literary advice and references from technical works. Replies to general technical questions.

   Section II.—This constitutes the experimental research department, arranged for the trial and testing of gas, benzine, and petroleum motors, steam-engines, water-wheels, turbines, and electro motors, as also all labour-saving machinery at agreed charges.
5. The chemical laboratory, which occupies itself with investigations of all kinds relative to technical and industrial chemistry, and further, is prepared to undertake analysis, and to carry out more

extensive researches for fees to be arranged. The official testing station for paper is in connexion with this branch.

6. A permanent exhibition of modern industry and art. Temporary exhibitions of special departments of manufactures. Distribution of prizes to meritorious exhibitors out of a fund founded by King Ludwig of Bavaria.
7. Issue of the Bavarian trade journal delivered to subscribers of the institution at the price of 10 marks; to non-members 16 marks per annum. This is the official organ of the Bavarian Industrial Museum.
8. The delivery of public lectures and addresses during the winter months, embracing information on all subjects of art applied to industry and every branch of manufacturing activity. Lectures to the members of allied societies in other towns. Classes for technical drawing for adults engaged in industrial pursuits.

An interesting feature in the activity of this Museum which was brought under our notice was the so-called Gewerbe-Archiv, or factory register, which includes a brief account of all the more important industrial establishments in Bavaria, contributed by the manufacturers themselves on a special form. The particulars given are as follows:—The name and address of the firm; when founded; articles produced; whether special to this undertaking; character of motive power employed; nature of machinery used, and the number of each kind of machine; patents, trade marks, &c. owned by the firm, with indication of registered number, &c. of the same; exhibitions in which the firm have taken part, and prizes and medals awarded. Further, as optional information, the number of workpeople employed and the annual value of productions. Many thousands of manufacturers have already contributed to this register, and every effort is made to keep it up to date and to render it accurate and complete as a record of the whole of the industries of Bavaria.

The assistance in the matter of patents, merchandize marks, and trade marks offered by this establishment seems very comprehensive and embraces much of the work done by the patent agent in this country. The payments received in remuneration for these and similar services by the staff are placed to the credit of the Gewerbe Museum, and are employed in amplifying the collections and extending the work of the mechanical and technical sections. We were conducted over the new building and saw the museum rooms, library, and lecture hall. The chemical department will be in a separate building, and it is at present housed in temporary premises. The various departments are well arranged and the museum is very extensive. The cost so far is upwards of 40,000*l.* The collections at the time of our visit were for the most part stowed away in consequence of the building operations. We were much pleased with the design and fittings of the libraries and museum rooms, which are admirably adapted to their purpose, and the building, when finished, will serve as a model for institutions of this character, which appear to be multiplying in Germany. The officials and staff of this Museum have been largely engaged in connexion with the Nuremberg Exhibition, and to them and to the able Director of the Gewerbe Museum, Herr von Kramer, the success of the undertaking is largely due. We received the utmost courtesy and kindness from these gentlemen, and we owe to them the facilities afforded to us for visits to several important factories.

The Stuttgart Exhibition.

The Stuttgart Exhibition of 1896 comprised two distinct sections, each of which was contained in separate buildings, namely, an electro-technical division, displayed partly in the Städtische Gewerbe-halle, erected by the Municipality for the Exhibition of 1881, and partly in the town gardens adjoining the same, and the artistic-industrial section, which occupied the ground floor of the handsome new Landes Gewerbe Museum, recently erected at a cost of nearly 200,000*l.* to contain the collections and staff of the Centralstelle.

The architect of this latter building, Professor Neckelmann, has most ably overcome certain difficulties entailed by the irregularity of the site, and has created a series of beautiful façades and a magnificent central hall, which latter has been named the König Karl Halle, as a memorial of the late King Charles.

The principal front of this museum towards the Kanzleistrasse has two arcaded storeys, with a lofty attic, flanked by circular towers, which conceal the unequal angles formed by the side streets. The grand staircase is in the central hall, which is surrounded by the frescoes painted by Professor Keller, and this was regarded as the place of honour of the Exhibition, and was reserved for the chief exhibitors in jewellery and the precious metals. Prominent in this section was the fine centre-piece contributed by Messrs. P. Bruckmann and Sons, of Heilbronn, who are among the largest silversmiths in Germany, and the collective exhibition of the Gmünd manufacturers, to the number of ten in all.

The Electro-technical exhibition, in which upwards of 400 exhibitors took part, not only filled the Gewerbe-halle and a temporary annexe for machinery, but it also occupied a specially-erected house in the adjoining grounds, in which every possible process connected with the domestic applications of electricity was shown in operation. A so-called "Gewerbedorf," or industrial village, adjoined the main building, and comprised all kinds of small industries in which electricity was called into play, either as a motive power, or for heating and lighting; these applications being, as a rule, shown in action. It was an admirable conception on the part of the architects, Messrs. Schmohl and Stähelin, to give to the buildings composing this village the character of some of the mediæval structures of Würtemberg and the ancient dwelling-houses, recalling, as they did, the past industrial activity of Southern Germany exemplified, in their use on the present occasion of the most recent applications of electricity, the vast improvements with which modern science has endowed the workman of to-day.

One of the buildings in this village was a facsimile of the birth-place of Schiller at Marbach, and contained a collection of original letters, early editions of his writings, medals, statuettes, paintings, and various objects intimately connected with the life and activity of the great poet.

Among the industries to which electricity was applied were cookery in its various branches, sausage manufacture, baking bread, and bon-bon making. Further on were shown printing and type casting, also electrically-driven printing machines. Liquid carbonic-acid gas was used in various ways as a motive power for beer-engines and pumps. There were also electrical toys of all kinds, sewing machines driven by small electro-motors, weaving, straw-hat making, all varieties of electro-plastic art and electro depositing, electro-gravure and photogravure; lastly, a special chamber devoted to a display of the famous Röntgen rays, which proved a great attraction.

On the upper floor was a quaint mediæval inn with its characteristic wall-paintings, and its waitresses in national costume. The decorative painting and the appropriate enrichments of the village were carried out by the scenic artist of the Court Theatre, Herr Plappert, assisted by Herr W. Reinwald.

In close proximity to the village, in the neighbouring Stadtgarten, was the "Schuckert-haus," an ornate villa entirely erected by various firms, either to exhibit building materials, fittings, or furniture. The whole of the domestic appliances, as also the cooking, heating, and lighting, were actuated by electricity, the lighting installation was carried out by Messrs. Schuckert of Nuremberg, now the Elektricitäts-Aktien-gesellschaft. Adjoining this cottage was an ancient water-wheel, supplied with water by an electrically driven turbine, manufactured by Voith, of Heidenheim, to contrast the new sources of power with the old. The mill-race led into a small lake, and the illumination of the wheel and sparkling water with electric lamps of various hues, was one of the nightly attractions of the Exhibition. In the upper floor of the Schuckert-haus was a restaurant, all the cooking for which was done by electricity, and on the ground floor was a workshop, with metal stamping

cutlery, and bonbon making, with electrically driven machinery. At the summit of the tower, which was reached by an electric lift, was a powerful search-light, used to illuminate the grounds at night.

The new Landes Gewerbe Museum, which was opened for the first time in connexion with the present exhibition, will take over the work of the Centralstelle, and will contain the valuable collections formerly housed in the Legionskaserne. Some of these objects were acquired so far back as 1849 at Paris and at Leipsic in 1850. Among the museum collections special mention should be made of the "Musterlager" or pattern depôt, the object of which is to bring before the manufacturer the most important improvements and modifications introduced into various trade processes, the most recent tools and appliances adopted in other countries, the best sources of raw materials and the chief markets for produce, while an effort is made to supply the latest information likely to be of value to the manufacturers and workpeople of Würtemberg. This collection is divided into 16 classes, and comprises upwards of 21,000 exhibits.

The Art library, with about 4,000 volumes of drawings and designs, and the Science library, of 53,000 volumes, have been specially arranged to aid the manufacturer and the art workman. The collection of casts, with about 1,700 specimens, is housed in the top floor of the Museum in well-lighted galleries. The admirable collections of furniture, metal work, glass, and porcelain are displayed in specially designed galleries round the central court, and some fine examples of Chinese and Japanese art form an adjunct to the art section of the Museum. During the present exhibition a considerable part of the floor-space of the museum is used for the Art Trades' Exhibition. The spacious entrance hall contained on the right a fine collection of musical instruments for which the country is famous, and on the left an interesting display of church furniture, decorations, and metal work, wood carvings, and some splendid embroideries. Passing through this department, we entered the gallery devoted to the textile industries, largely linen, much of which is richly embroidered, and here also were shown embroideries and needlework from the various women's work schools. The next range of galleries contained the collections of wood-work, common furniture, clocks and pottery and porcelain, also some carving in wood and ivory. The central hall and the galleries to the right and left contained some of the finest examples of the industries of Würtemberg, the gold and silver work and the art furniture. The library on the first floor was temporarily occupied by the display of the graphic arts, and the lecture room was given up to the pianofortes. The upper galleries of the central hall contained the leather work and collections of porcelain, glass bronze, and metal work. There were upwards of 200 exhibitors in this section of the Exhibition, and in point of excellence of workmanship and artistic design we should be disposed to award the place of honour to the exhibition of silversmith's work and jewellery. We were less pleased with the furniture, which was on the whole somewhat massive and overladen with ornament. A special building was erected, adjoining the Gewerbe Halle for the heavy machinery, and the smaller and lighter objects were displayed in the Gewerbe Halle, which lends itself admirably for exhibition purposes.

One of the most important collections here shown was that contributed by the Würtembergische Metallwaren Fabrik of Geislingen, where every description of electro-plated goods are manufactured on the most extensive scale. The designs and execution of many of the objects, which were very tastefully displayed, showed great merit, and we should be inclined to assert that in no branch of her industry has more progress been made in recent years in Würtemberg than in the manufacture of gilt, silver-, and nickel-plated metal work. It is here, moreover, that the assistance of the skilled craftsman and designer has been most fully called into play, and some of the best artists of Germany have been associated with the productions of Geislingen. A new process of metal work which greatly interested us was the so-called "galvano-bronze" by means of which an electro-deposit of great thickness and of guaranteed durability is encrusted upon plaster. Large statues and very substantial architectural details have been produced in this way, and it is claimed that the works,

though far cheaper, are quite equal to an ordinary bronze casting. A peculiarity due to the mode of production is that these objects are entirely devoid of the usual metallic sound on being struck. The results of this process were, we believe, here exhibited for the first time upon a large scale.

The Nuremberg Exhibition.

The Bavarian National Industrial and Art Exhibition, held this year at Nuremberg, was situated in the beautiful public gardens to the north of the city, and occupied the same site as the previous Exhibition visited by us in 1882. It was contained in handsome and appropriate buildings specially erected for the purpose from the designs of Herr v. Kramer, the Director of the Gewerbe Museum. The style chosen for the main building was that of the Classic Revival; the buildings were wood-framed, covered with cement slabs and plastered; the external colouring being pure white. The general elevation contained a single order with entablature which was sufficiently lofty to mask the roofs of the sheds behind. This arcaded façade served as a corridor of communication and was quite distinct from the buildings at the back. The central pavilion of the industrial section, which was much more lofty than the wings, was crowned with a well-designed cupola, supported by a group of columns with arched interspaces. The wings were terminated by quadrants and pavilions with double archways surmounted by obelisks. The general arrangement of the main building was that of a lofty central hall, from which branched out on either side a series of smaller transverse courts at right angles to the main gallery. The large hall had an open timber roof, and this was heavily festooned with garlands of pine branches, which, contrasting with the brown timber, had an excellent effect. This hall, for a considerable part of its length, was free from exhibits, and furnished a wide and spacious promenade. The side galleries were allotted to the eight provinces of Bavaria, and each province fitted up and decorated its own space without any regard to what was being done by its neighbour. By this plan there was a charming variety in the methods of treatment and arrangement, but an entire absence of classification in the objects exhibited, which was productive of some confusion in the mind of the visitor. Thus in passing from gallery to gallery there would be found side by side in one court cotton textile fabrics, in another wines and leather, and in a third pianofortes. Moreover, the decoration of each of the main entrances to the courts was left to the initiation of the separate provinces, and each province had designed a special portal or trophy to mark its own department, and entrusted some talented decorator with the colouring and completion of the plain timber structures allotted to it by the Exhibition authorities.

At the further end of the main hall was the portal giving access to the Province of Middle Franconia, in which Nuremberg and some of the chief industrial cities of Bavaria are situated, and the space allotted to this province was more than double the size of any other. The entrance portal was, by a happy idea of Herr v. Kramer, who was charged with the decoration of this section, designed as a free reproduction of the triumphal arch erected in 1612 on the occasion of the entry into Nuremberg of the Emperor Matthias. At the extreme end of the hall was the colossal picture of the market-place of Nuremberg by Herr W. Ritter. The chief manufacturers of this province, who had secured large and prominent spaces in the central hall, had arranged their exhibits as trophies; noticeable among which was the display of a soap-maker with life-sized figures and architectural details modelled in hard soap; a vast collection of bicycle accessories with cycles of all kinds, and their riders the size of life; and the fine collection of pencils and artists' materials contributed by the rival firms of A. W. Faber and J. Faber. An artistic selection of the works of Mr. E. Nister in engraving and chromo-lithography occupied a special court. Some of the methods of display were very quaint, thus the united ultramarine manufacturers had arranged a blue grotto in which their productions were seen to great advantage. Many of the industries united to

form joint exhibitions; this was the case with the Fürth toy-makers and the representatives of the various minor industries which have been established in that town, among which may be noted mirror and looking-glass manufacture, metal foil and decorated sheet metal work of all kinds, including wirework, and spangles and sequins in great variety.

The courts on the right of the central hall were allotted to Upper Bavaria, Lower Franconia with Aschaffenburg, and Upper Franconia, and those on the left to the Rhine Palatinate, the Upper Palatinate with Ratisbon, Lower Bavaria, and Swabia with Neuburg.

We can only mention in passing a few of the prominent objects in each section which attracted our notice. An important place in the display from Upper Bavaria, in which province is situated Munich, the capital, was assigned to jewellery and goldsmiths' work, among which was a fine reproduction of the Jamnitzer centrepiece and some excellent enamels. The porcelain manufactory of Nymphenburg still retains the characteristic forms and decoration of the last century for many of its productions. Some of the great breweries occupied an unnecessary amount of space in order to pile up vast trophies of beer barrels, and the representation of certain industries was disproportionate; thus a tea and coffee merchant had acquired a large court in which, by means of a series of pictures, he illustrated the growth and preparation of tea and coffee in Ceylon and South America. Special efforts had been made by the wine growers of the district of Lake Garda to call attention to the excellence of their wines. The graphic arts were well represented by the displays of Messrs. Knorr and Hirth, Meisenbach, Riffarth, & Co., and others. The shoemakers of Munich, to the number of 22, had a collective exhibition, and with it were shown the works of the Fach Schule for the training of apprentices to the shoemaking trade, with specimens of the teaching appliances and students' works and note-books; the anatomy of the foot and the history of the art at all periods would seem to be studied with much care.

Considerable trouble had been taken to represent the industry and activity of some of the more remote parts of the province, the wood-carving and furniture of Berchtesgaden was shown by a collective display of 17 exhibitors, prominent among which was the work of the drawing and carving school. It was evident that great improvement in taste was being effected by the agency of this school, established under Government auspices. The school, which was founded in 1840, contained last year 32 students. The whole work of the school was well shown in a series of graduated examples in drawing, modelling, and carving. The Werdenfels district, of which Garmisch is the centre, also contributed a very tasteful display of its industries, in which 79 exhibitors took part. Here there were several collections of the carving-school work from Oberammergau and Partenkirchen; also a display of the works of the students at the violin-making school of Mittenwald.

The Werdenfels court was partly in the open air, and included an excellent panoramic picture of the local scenery. There was more diversity in the objects exhibited from this province than from any other part of Bavaria. The general decorative work was carried out from the designs of Herr E. Seidl, of Munich, and was very successful.

The court on the left of the one just described was allotted to Lower Franconia with Aschaffenburg, and the decorations in this case were carried out by Herr F. Gaab. This province, famed for its vineyards, made great efforts to bring its excellent wines to the notice of visitors, and many charming little stalls were fitted up for tasting the various vintages. The Stein-wein of Würzburg is known throughout Europe; many of the chief wine growers united to form a collective exhibition. The proprietor of the flourishing Portland cement factory at Karlstadt had here fitted up a complete laboratory, furnished with all the necessary apparatus for the scientific testing of cement, with specimens of raw materials and of the cement in all stages of its manufacture. Moreover, the high state of agriculture in this province was exemplified in a beautiful open court arranged as a garden, with specimens of vine culture and other cognate industries.

Passing onwards, the next court we entered was devoted to the industries of Upper Franconia, in which Bamberg and Bayreuth are the most important towns. The industrial societies of the former city united to contribute a collective exhibition of a very successful character. It took the form of a chapel with stained glass windows, wall decorations carved altar-pieces, handsomely bound missals, and rich embroidery. Much of the furniture in this section was interesting and characteristic, the designs being based on the mediæval models. The basket-makers of, the Lichtenfels district also formed a collective exhibition in which a prominent place was given to the local basket-work and drawing school, which has contributed so greatly to the improvements effected in the productions of this neighbourhood. We were told that the entire display had been purchased for America. The granite from the quarries in the Fichtelgebirge is widely used, and was well displayed in a special court. The textile manufacturers of Münchberg and the vicinity, who have greatly benefitted by the weaving school founded in 1855, made a collective display of their productions, the centre of the court being allotted to the school work which embraced examples of both practical and theoretical teaching. The work in this neighbourhood is still chiefly done on handlooms. The school has an average attendance of 18 students.

This completes the courts to the right of the main hall, and, as already stated, all the end farthest from the entrance was devoted to Middle Franconia and its products; these we have already described, so we pass on to the furthest court on the left, allotted to Swabia. The chief industries of this region are the important cotton spinning and weaving mills situated round Augsburg, some of which have been paying dividends of 15 per cent. and upwards, while the cotton trade in Lancashire is languishing. The principal manufacturers contributed to a joint display, representative of their activity; in most cases there were excellent drawings of the factories, which are, many of them, of a very large size. Second in importance are the metal industries of Augsburg, which were here well displayed. The admirable decorations of this court were designed by Herr L. von Kramer, the eminent professor at Munich. A charming little open air court had been arranged in this section for the tasting of the celebrated Algau cheeses, with a realistic model of a mountain farm, surrounded by a well-painted panorama of the vicinity of Oberstdorf in the cheese country. The industries of Algau, moreover, were well shown in the adjoining court, the straw hat manufacture, and the many useful articles made from the excellent fir timber.

The next court was occupied by Lower Bavaria, the entrance doorways being copied faithfully from ancient examples in Passau. The industries of this district are of secondary importance. We have noted some good glass blowing and decorative work in glass, and a grotto or cavern composed of the residue from the glass-houses; also specimens of many small trades peculiar to certain localities, which depend upon the ample supply of cheap timber from the forest districts, as for example, wooden boxes, sieve frames, matches, laths, and wood shavings. The most striking feature in this section was the open-air court with its fine panoramic views and its typical cottages and wood-working plant. Some peasants in costume were engaged in carving and the making of matches; tinder-fungus, caps, and other characteristic industries which are carried on in the mountain villages; and there was also a little roadside inn, where the curious drinks, and liquors flavoured with herbs and fir-tree needles could be enjoyed under proper conditions and with their true surroundings.

The Upper Palatinate with Ratisbon were the tenants of the next court passing onwards in the direction of the entrance. In this section also, although there was nothing very striking to attract the attention in any important group of manufactures, the various industries were well displayed. The most interesting feature here was the reproduction of the Chapel of Saint Thomas at Ratisbon, which dates back to the 14th century, and formed part of the collective display of the Ratisbon Trade Society.

This chapel was somewhat inappropriately used as a restaurant. Ratisbon also contributed some good ecclesiastical furniture and decorative work.

The last of the courts on the left was devoted to the contributions from the Rhine provinces, largely represented by the vineyards and wine of the Palatinate. Here, again, there was much variety in the character of the objects displayed. In some parts the cotton trade flourishes; there are also extensive cement works and potteries. Some very good furniture was here shown, and much basket-making is carried on. The women's work school at Kaiserlautern sent some good needlework and embroideries, and the trade museum of that town some specimens of carving and metal-work carried on in the classes under its auspices. The great colour industries of Ludwigshafen we must describe in another place.

We repeatedly found the practical work done in the so-called Gewerbe Schulen, or trade schools, prominently displayed and carefully arranged. Schools of this character, in which a large amount of practical teaching is provided, are widely distributed over Bavaria, and, as was mentioned in the Appendix to the Report of the Commission, published in 1884, have had a most beneficial influence on many of the minor local industries. These schools still appear to be flourishing and to be accomplishing useful work.

A special section of the Exhibition building was devoted to the display of the work of the higher schools, both for artistic and industrial training. It was interesting to find side by side the collections contributed by the two great Industrial Art schools of Bavaria, the Art school of Munich and that of Nuremberg. Here were to be found examples of the designs of the students in all the various departments of art industry covered by the very extensive programme of these institutions. Thus at Munich, where the male and female students work in separate divisions, there were very complete sets of specimens of the whole course of work comprised in each section. Decorative painting, industrial design, wood engraving, glass painting, metal chasing, and carving are all practically taught, and the specimens of school work were extremely good. It would be difficult to say whether the designs from this school or those from the older school of the same rank at Nuremberg, which also had a most admirable collection of students' works, were entitled to the place of honour. In its modelling and in some branches of applied art perhaps Nuremberg should take the first place, while we should award the palm for decorative painting, studies from the life, and stained glass decoration to the Munich Art School. The former school sent some extremely meritorious specimens of the work done in its evening classes by apprentices and workpeople. It would seem that the Munich school secures a larger number of middle-class day students than Nuremberg does. We have little hesitation in stating that both of these schools still stand in the highest rank for the admirable character of their applied art teaching.

The Royal real-gymnasium of Nuremberg contributed a large collection both of the works of its students and of its teaching apparatus, also a cabinet of minerals and fossils for school use. A similar collection was sent by the Nuremberg Kreis-realschule.

One of the most important displays in this section was that made by the Industrie Schule of Nuremberg, which comprises sections for mechanical technology, chemical technology, and building and architectural work. This school gives in its workshops and laboratories a very complete course of practical teaching, as evidenced by the specimens of machinery and the drawings and models from the mechanical section, the important collection of chemical preparations and apparatus from the second section, and the architectural details, wood models, and designs for buildings of all kinds representing the building trades' section of its activity.

Another school which confines itself more especially to instruction in building and engineering, the Building Work and Mechanical Construction School of Nuremberg, only founded in 1870, appears to be well attended both as a day and evening school, and sent a very extensive series of students' drawings of great excellence and embracing nearly every branch of building operations.

The display of school work was fairly representative of all the different types of secondary schools, and there was a very good collection of evening school work, and of the teaching in women's work schools and night classes for artisan students. We spent a considerable time in the examination of this section of the Exhibition. In a neighbouring court we found a series of examples of the displays made by some of the leading manufacturers of Bavaria at the Industrial Exhibition of 1840. It was, indeed, astonishing to contrast the samples of the products in that year with the specimens of the activity of the same firms on the present occasion; a few bundles of rough pencils being representative of the huge factories of the Fabers, and some small glass saucers, filled with colours, sufficing to display the activity of the vast enterprises which have been created in the colour trade.

In connexion with this portion of the Exhibition were the splendid collections sent by the Department of State Railways, the Post and Telegraph Administration, the Royal Mint, and certain Government departments under the Ministry of the Interior, viz., those for mining, river purification, water supply, public works and buildings, fire insurance, and meteorology.

Mr. Knorr's Conserven-Fabrik, Heilbronn.

We visited on Tuesday, September 22nd, the factory at Heilbronn of Herr Carl Knorr, a large producer of preserved vegetables, macaroni, crushed oats, compressed soups, "erbst-wurst," and tinned and packet foods of all kinds. He employs 600 hands, and prepares some 800 different articles of food. The factory is a handsome modern building close to the town. The trade mark, "The Bee-hive," is carved in relief in stone over the entrance. The excellent red and grey sandstone of Heilbronn here employed is used largely in Würtemberg as a building material. The town is supplied with electricity from the falls of the Neckar at Lauffen. The wires laid down in 1891 to transmit power to Frankfort passed close to Heilbronn, and after the Exhibition the works, capable of furnishing 300 horse-power, have been retained for the supply to this town.

We were taken through some of the principal departments of the factory, and saw first ingenious automatic machines for making the cardboard cases used for packing oatmeal, &c. These machines were constructed by Messrs. Hesser, of Cannstadt, and were said to be protected in all their details by numerous patents. Girls were tending these machines and feeding in the cardboard punched into suitable shapes. The folding machines were apparently adapted from those of a similar kind used for making envelopes. We saw next the closing of tin canisters by means of flanged rings turning down over an india rubber washer; this was accomplished by means of a small pressing machine, resembling that used for fixing metal eyelet holes. This india-rubber fastening was said to be superior to metal soldering. The tin-plates came from England.

Over 100 young women and girls were seated at long tables, filling meal and soup compounds into cardboard cases and packages. Some of the packets were being carefully weighed. In an upper store-room we were shown samples of all the different kinds of dried vegetables prepared by the firm. These were shredded into strips, and comprised cabbage, onions, beans, carrots, potatoes, turnips, &c. In a warehouse on the ground floor, peasants were bringing in small handcarts laden with cauliflowers, French beans, cabbages, &c., which were being examined and purchased. Other women were taking away sacks full of kidney beans to be stripped by hand. We were told that the pay for this, by piecework, was 1s. per cwt. Some ingenious machines were at work shredding the beans into slices. Women were engaged in cutting up cabbages into small pieces, and cleaning out insects and decayed or injured parts. In every operation we could see that strict cleanliness was enforced, and precautions had been taken to avoid bringing dust and dirt into the work-rooms.

In order to prepare them for the market, all the vegetables are lightly boiled by blowing in steam into huge vats. This process appeared to be little more than scalding, after which they are taken out in wire strainers and dried in hot-air stoves until all water is expelled. Subsequently they are compressed into cakes in small presses, a thickness of about eight inches being compressed to less than one inch. A large business is done in crushed oats, similar to the preparation known in this country as grits or rolled oats.

The women engaged in handling the oats and in certain other parts of the factory wear blue striped cotton blouses, which Mr. Knorr himself supplies, provided the women will remove their corsets, as they are able to move much more freely without them, and can work under more healthy conditions. Special dressing rooms are provided in which they can put on their working clothes. In connexion with these rooms are meal rooms, where food and drinks are sold at very low prices. Any profit made in carrying on the canteen is divided, half being set aside for the pay of the caretaker and the other half goes to the sick fund. Mr. Knorr contributes annually a share of the profits for distribution among the workpeople, and those who have been long in his employ get increased shares. He assured us that his staff was paid larger wages than those paid by any firm in the neighbourhood, and he has never had any strike. No doubt the wages in this locality are lower than those in this country, and by means of the Neckar and the Rhine he can send goods by water to the sea-coast at 2*s*. per cwt.

We were conducted over the factory for macaroni, vermicelli, and Italian paste. The paste made of flour and eggs is kneaded by machinery and forced by hydraulic pressure through finely perforated metal plates. An air-jet serves to free the product from the dies. The various articles made of paste are dried in hot stoves and packed in boxes by girls. In the cellar we were shown the egg store where the (Italian) eggs are stored in lime-water for the winter months. The eggs come packed in boxes, and every egg is carefully examined by experts before it is put away. Some two million eggs are used annually.

For the manufacture of certain kinds of soup, Mr. Knorr uses green wheat gathered rather before it is ripe. This has to be specially obtained from the farmer at an enhanced price, and we were shown a large warehouse filled with green wheat in bags said to represent 5,000*l*. in value.

We next saw the department for the manufacture from pea-meal of the famous "Erbst-wurst," supplied to the German Army. Formerly each ration contained a certain quantity of meat-extract (Cybil's), now the meat extract is given out separately to the soldier. The pea-meal is stirred by machinery, and a small quantity of bacon fat is introduced along with it. For this purpose the best Westphalian bacon is used. It is cut up into small cubes and fried in large pans. In the bacon store in the cellars were many thousands of sides of bacon hung up ready for use. All kinds of soups are prepared, and flavoured with various vegetables. The stock in every case being the "Cybil" meat extract. The soups are made up in tablets ready for use, and merely require 15 to 20 minutes' boiling for the table.

Another speciality of the company are the so-called "grated-rusks" for cutlets, hams, fish, &c. These are to take the place of the bread crumbs commonly used; here they are made as special loaves, which are pulverised by machinery and put up in tins for use. Every variety of farinaceous food is made here, such as crême d'orge, farine de lentils, fécule de pomme-de-terre, &c., also special nutritive foods for infants and invalids, which are prepared in vast quantities. Mr. Knorr has contracts for dried vegetables for the German Army and Navy, the North German Lloyd steamers, and with many foreign Governments for army and navy purposes.

We visited next the packing rooms where the various products were being stowed away in large wooden cases, and specimens of circulars in many foreign languages were shown to us; English circulars and show tablets were not wanting among them. In the counting-house we found a large

staff of clerks, and Mr. Knorr informed us that he had supplied our recent Ashantee expedition with a stock of preserved vegetables.

All the qualities of meal employed here are ground in the works, and the mills fill a large special department of the factory. The vegetable stores are very extensive, but at the time of our visit they contained only a large supply of onions. Mr. Knorr informed us that a considerable area round Heilbronn is given up to the growing of the different vegetables needed by him, which he purchases from the farmers at a fixed tariff. Vines are also extensively cultivated in the vicinity, and the vegetables can be grown with the vines; a good year for vegetables is a bad year for grapes, and *vice versâ*. This vast industry has been entirely built up by Mr. Knorr and his late brother. The works contain all the requisite repairing shops for the machinery and engines, carpenters' shops, saddlery, and coachbuilding department, &c.

We were shown a smaller factory in the town where the trade was started some 25 years ago, and eight years ago the business was removed into new and greatly enlarged premises. We were surprised by the extensive scale and importance of this concern.

On a visit to the Stuttgart Exhibition we found that 600 of the work-people had been brought up by special train to spend the day, and all costs had been undertaken by the firm. Each employé on that occasion had a distinctive badge, to which dangled a small model "Erbst-wurst," at once a ready means of identifying the members of the party and an excellent advertisement!

Mr. E. Nister's Colour Printing Works, Nuremberg.

We visited on September 24th the extensive colour printing works of Messrs. Nister & Co. in a large building recently erected near the Laufer Thurm, seven stories high, in the style of the ancient architecture of Nuremberg. Over the main entrance, inscribed in letters of gold on a marble tablet, was the following sentence:—

"What work has won, Through the long centuries,
Work will retain Thus God decrees."

We were received in the offices of the director, M. Theodor Loefftz, a richly decorated suite of rooms, one of them fitted up with glass cases containing a very interesting collection of the productions of the firm, which comprised Christmas, Easter, and birthday cards of all kinds, fancy almanacks, children's picture books, and decorated porcelain. The decoration of pottery with chromo-transfers, at first practised by French manufacturers, has been recently introduced here, and great perfection has already been attained in this branch of work. Large sheets of transfers are prepared, and after being printed over the glaze are fixed in the enamelling kiln, giving the appearance of the finest hand painting at a very cheap rate. We did not see any gilding by this process, but the figure painting and much of the flower painting were very delicate and refined. It appears that Mr. Nister's process has not yet been taken up in England.

The taste of the cards and picture-books was eminently that of the English and American markets, and we were assured that nearly all the designs were made in London, where the firm have an atelier at Amberley House, Norfolk Street, Strand, and a staff of artists constantly employed, and that the bulk of the productions of this establishment are sold in London and New York. The firm of Dutton & Co. represent Nister's in New York. In London they have their own branch depot at 24, St. Bride Street, and 28, Paternoster Row. At Nuremberg they have 140 lithographic artists engaged in drawing on the stone itself, or on prepared transfer-paper to be applied to the stone. Their chief artist, Herr Kühn, is a most eminent member of the profession and one of the foremost etchers in Germany. We saw a gallery filled with his paintings and etchings at the exhibition, and among them some very clever portraits.

Many of the lithographers are trained on the works, and attend the Kunst-Gewerbe Schule at night, and M. Loeffte bore willing testimony to the advantages derived from the Art school. In the case of elaborate designs many separate stones have to be used, and each stone has to be worked up and prepared for its particular colour. We saw designs in all stages, mostly for picture-books and cards. The Christmas cards for 1896 are already in the market, they are engaged on the supply for 1897, and even on the almanacks and calendars for 1898.

In the various workshops we were shown all the different processes of embossing and stamping cards; the latter in hand-presses furnished with powerful lever handles. Nearly all this work was being done by women. We also saw the folding and binding, employing many workpeople, the binding is chiefly done by men. Passing into the printing room, we found numerous large steam-driven presses at which, in most cases, one man and two women were employed. It is usual to put numerous copies of the same design on the stone, so that as many as 20 impressions of the same subject are printed at once. The stones used are about 4 feet square. Some of the presses were rotary, others were of the earlier type. All the machinery was German. We saw women engaged in dusting the back of the sheets with powdered French chalk to prevent the pages from sticking together. In another department we saw the chromo printing for the pottery transfers. This is quite a similar process to the ordinary chromo printing. We were conducted to the oldest part of the works, where we were shown the photogravure and various photographic reproduction processes, and we saw also the special department devoted to etchings.

The women workers at this establishment earn, we were told, from 8*s*. to 12*s*. per week, and there can be no doubt but that the lithographers and artistically trained workers earn wages but little lower than those paid to similar workpeople in this country. It must be remembered, however, that colour-printing of this kind has long been practised in Nuremberg. Still it is strange to find in this far-off city a hive of busy workers nearly all whose productions are destined for England and America. We watched the workpeople leaving at the dinner-hour, at which time everyone goes home, and we were very favourably impressed with their general appearance. There are about 750 hands engaged at this period of the year.

The display of Mr. Nister's works at the Exhibition was most artistic. The cases, covered with green plush and decorated with ormolu work in the "Adams" or "Empire" style, were beautifully designed, and the wonderful variety of choice cards, engravings, and illustrated picture-books greatly interested us.

The works of the firm in question are but types of many similar establishments for colour-printing on the Continent, working largely for the English market. At Stuttgart we were shown the works of Mr. M. Seeger, who produced the illustrated advertisement of the Exhibition, the Figure of Electricity, taken from Professor Keller's fresco. The German lithographer has some advantage over his English rival in the relatively much lower cost of the lithographic stones, which comes from Solenhofen, in Bavaria, but we were told that the best of the stone is exported to other countries, and only cheaper qualities are used for the home trade. A very considerable capital must be sunk in the supply of stones for a large works. The artist at Herr Seeger's told us that the bulk of the work was not drawn direct on the stone but on prepared transfer paper, which reversed the drawing and enabled the draughtsman to follow the design as it would appear when printed. Herr Seeger does not do any work for England.

Another large establishment visited by us was the works of the Union Company, formerly Cotta & Co., the publishers of the writings of Schiller and Goethe. This is the largest printing concern in Germany, and probably in the world, as it employs 800 hands. We were shown all the different departments, including the atelier for the engravers and the colour-printing. This firm produces its own type in a special factory, and

publishes several illustrated papers, some of them having coloured illustrations.

The Elektrizitäts-Aktiengesellschaft, Nuremberg.

By far the most important of the exhibitors in the machinery department in the Nuremberg Exhibition was the company recently formed to take over the flourishing business of Messrs. Schuckert and Company, now known as the Elektrizitäts-Aktiengesellschaft of Nuremberg. As we have already stated, Mr. Schuckert's business was established a few years previous to the earlier exhibition at Nuremberg in 1882, at which he received a gold medal for the excellence of his display, but at that date this industry was relatively of small importance. Last year this firm had in its employ 3,570 workpeople and officials, and produced machinery and apparatus of the estimated value of nearly a million and a half sterling.

We received permission to visit the large new works in the outskirts of the town into which the company has recently removed, and we also inspected the original factory, nearer the town, which served for the business when it was upon a more humble scale. The old works are now chiefly used for small electrical fittings and the mountings and small castings for lamps, &c. An important branch of the manufacture, the production of the famous search-lights, is not shown to visitors. We saw in the exhibition many specimens of these lights, some of them of very large size, up to nearly 5 feet in diameter, many of them fitted with electro-motors attached to the driving gear. These search-lights are a speciality of the firm, and have been supplied to nearly all the European armies and navies. The principal feature of the apparatus is a glass lens ground parabolically on both sides, and having its convex surface silvered. It contains also a horizontal arc-lamp, with a carbon holder adjusted to the axis of the reflecting mirror. The whole is enclosed in a metal case, mounted on a rigid foot or base. The strength of the current needed for the smaller search-lights varies from 25 to 40 ampères, and for the larger ones from 120 to 150 ampères. Special search-lights are made for torpedo-boats, cruisers, and harbour defences, and arrangements are made to mount the whole apparatus, together with a steam or petroleum generator and dynamo, on a transport waggon for army purposes.

We were conducted over the fitting shops, and saw innumerable dynamos of many different types in all stages of manufacture; some of them of very large size, and involving the use of heavy castings, but no iron casting is done by the company. The labour-saving machinery seemed very perfect, and the lathes and drilling machines were in certain cases of English or American make, but mostly German. An enormous business is done by this company in fitting up central stations for electric supply installations. Fifty such stations of large size have already been completed; among other places, at Aachen, Altona, Buda-Pesth, Christiania, Düsseldorf, Hanover, Hamburg, Munich, Nuremberg, and Stuttgart. The company are largely engaged in the manufacture of lighting plant. In our visits to electro-technological laboratories we found numerous evidences of the manifold activity of their enterprise, and in the course of our progress through the works we received abundant confirmation of the statement that the company are overwhelmed with orders. In fact the vast new works are already being extended, and we were assured that a large area of ground at the back of the manufactory would soon be built over. The company has already paid a dividend of 14 per cent., and the shares are at a high premium.

Our guide on the occasion of our visit was a young Englishman, the only one employed here, who received his first engineering training at the Crystal Palace School, and who was afterwards for three years with the Gulcher Company at Battersea.

The average wages to workmen are 28*s*. per week, and in many departments much is done by piece-work. The workmen certainly earn less in this industry than is paid for corresponding work in England, and the shop hours are longer.

The Badische Anilin- und Sodafabrik.

One of the most striking of the special exhibitions outside the main building of the Nuremberg Exhibition was the pavilion erected in the grounds by the prosperous Badische Anilin- und Sodafabrik of Ludwigshafen, founded in 1865 for the manufacture of colouring matters and other derivatives extracted from coal-tar. A practical illustration of the chief products was furnished by a heap of the raw material, representing 1,000 kilograms or, say, 1 ton of coal, and then in a group of bottles and flasks of various sizes arranged round it was the exact equivalent of each of the many dyes and essences which science has taught us to extract from this weight of coal. Here were the earliest dyes of the aniline series made by the company, the famous blue and the so-called fuchsine; then the artificial alizarine, dating back to the discoveries of Graebe and Liebermann in 1868, with the blues and the greens of the alizarine series, followed later by the anthracene derivatives and the gallic acid compounds. These were all shown in their due sequence and proportions, and some of the recently discovered colours were in very small quantities, indicating their relative rarity.

Illustrative of other branches of the activity of these great works were the dye materials known as eosin and the resorcin colouring matters, rhodamine, &c. Then the azo colouring matters, from which have sprung the "genuine black" and the so-called "brilliant black" dyes of commerce. The year 1891 witnessed the introduction of Indoin blue, an aniline dye capable of competing with indigo, and year by year new triumphs have been achieved by the scientific staff engaged at Ludwigshafen. This staff now consists of 100 skilled chemists, all of them holding diplomas, also 30 engineers and 230 clerks. Of the rank and file, which in 1865 numbered 30 workpeople, there were in 1870, 835; in 1888, 2,377; in 1895, 4,450; while this year the staff consists of no less than 4,800 hands.

The annual value of the colouring matters manufactured from coal tar is estimated at 5 millions sterling. Of this total Germany produces not less than three-fourths, of which, 75 per cent. is exported to other countries.

These works occupy an area of upwards of 210 acres, of which above 60 acres are covered with buildings. The amount of coal consumed is 190,000 tons annually, and there are 83 boilers and 190 steam engines with a total of 6,500 h.p. Among other things needed in the manufacture, no less than 12,000 tons of artificial ice are produced yearly, and all the acids and reagents required in the manufacture, such as soda, chlorine, nitric, hydrochloric, and sulphuric acids, &c., are made on the spot. The works are lighted by 470 arc lights and 6,400 glow lamps.

A very perfect and complete series of artizan dwellings has been erected by the company with provision for 492 families, numbering in all 2,900 persons. There are also 78 official residences for the staff, with dining halls and mess-rooms for the workpeople, an infirmary and convalescent home, baths, lying-in hospital, schools for both sexes, very complete arrangements for the sick funds and savings banks, and, lastly, a special pension scheme, to which the company contributed 10,000*l*. The extent of the site of the works can best be estimated from the fact that not less than 19 miles of railway sidings are in use, and the rolling stock comprises 312 railway trucks owned by the company.

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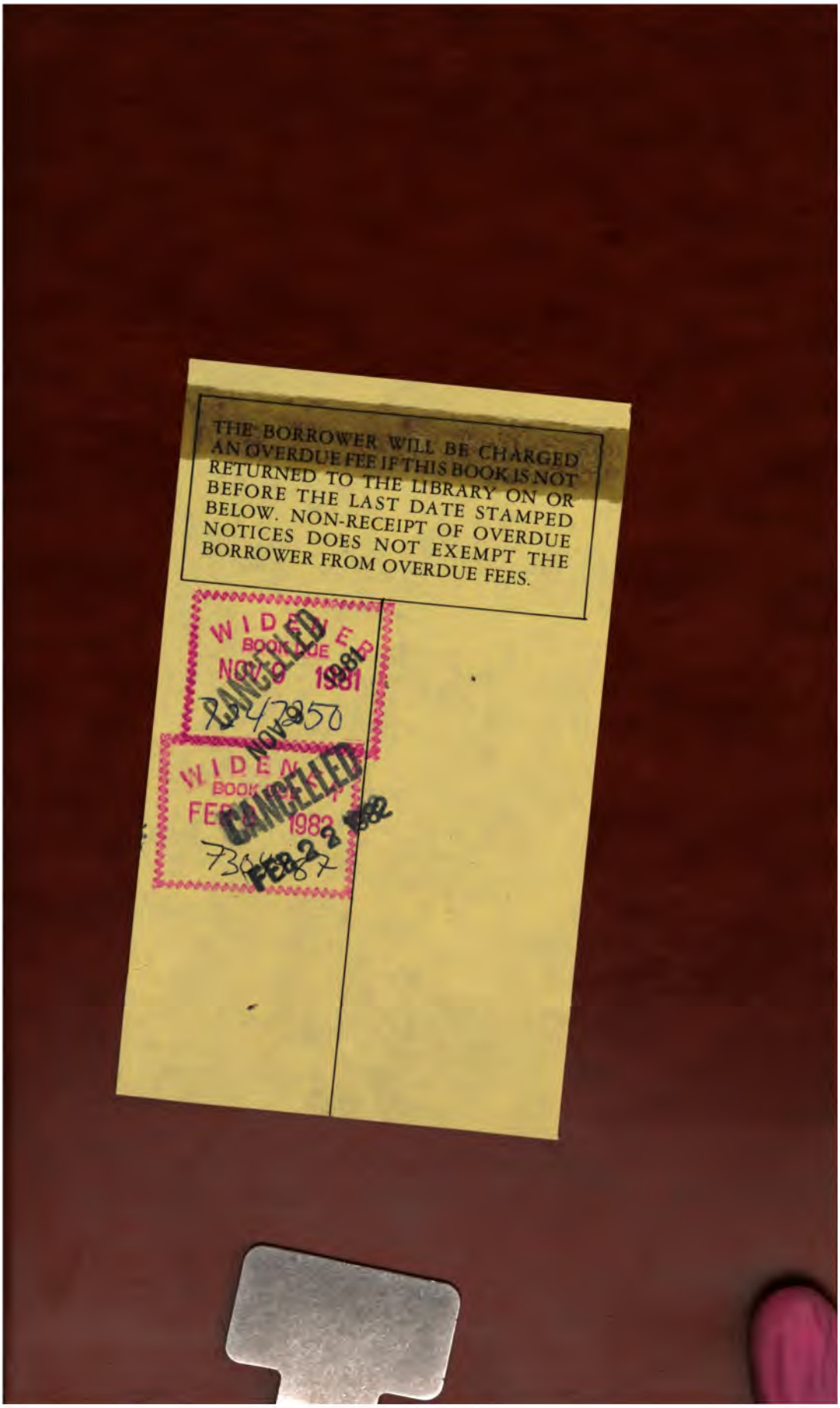
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